MORPHO-PARAMETRIC CLASSIFICATION OF THE INHALABLE FRACTION OF AEROSOLS IN THE INDOOR AND OUTDOOR AIR FROM A UNIVERSITY GYMNASIUM

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MOTIVATION

Particulate air pollution, specifically the fine particle fraction (PM2.5), has been associated with increased cardiopulmonary morbidity and mortality. However, this type of studies has been prioritized to open atmospheric scenarios and associated sources to a great extent. This contrasts with the time we spend indoor -either in domestic or working environments-, which far exceeds that of outdoors. Thus, there is a need to assess the health risks of the occupational exposure of the population to fine particle matter. Based on this, the World Health Organization already recommended a set of specific guidelines for indoor air quality (WHO, 2006).

AIM

To classify and quantify particle size morphology and type of the inhalable fraction inside a university indoor sports facilities

DESIGN & METHODS

As part of a major study to investigate the indoor air quality in sport facilities at the University of León (Spain), intensive aerosol measurements were made in a gymnasium for several consecutive days in July 2012 (Alves et al., 2014). Daily PM10 samples were collected during the period of maximum activity, onto nucleopore polycarbonate (PC) filters, to be investigated by microscopy means. The particles were deposited on a total of 6 indoor and 3 outdoor samples, and analyzed with a field-emission scanning electron microscope (Jeol JSM 6335F) equipped with an Energy-Dispersive X-ray Spectrometer (EDS, Oxford Instruments, X-Max model).

Size, morphological parameters and elemental composition from the individual particles were obtained. Thanks to this information, particles were classified through a set of parametric rules, into 6 different clusters (Coz et al., 2010): (1) mineral dust, (2) primary biogenic organic aerosols (PBOA), (3) other organic compounds, (4) nano-salts, (5) soot and (6) miscellaneous (non- classified particles).

Indoor & outdoor particle cluster types

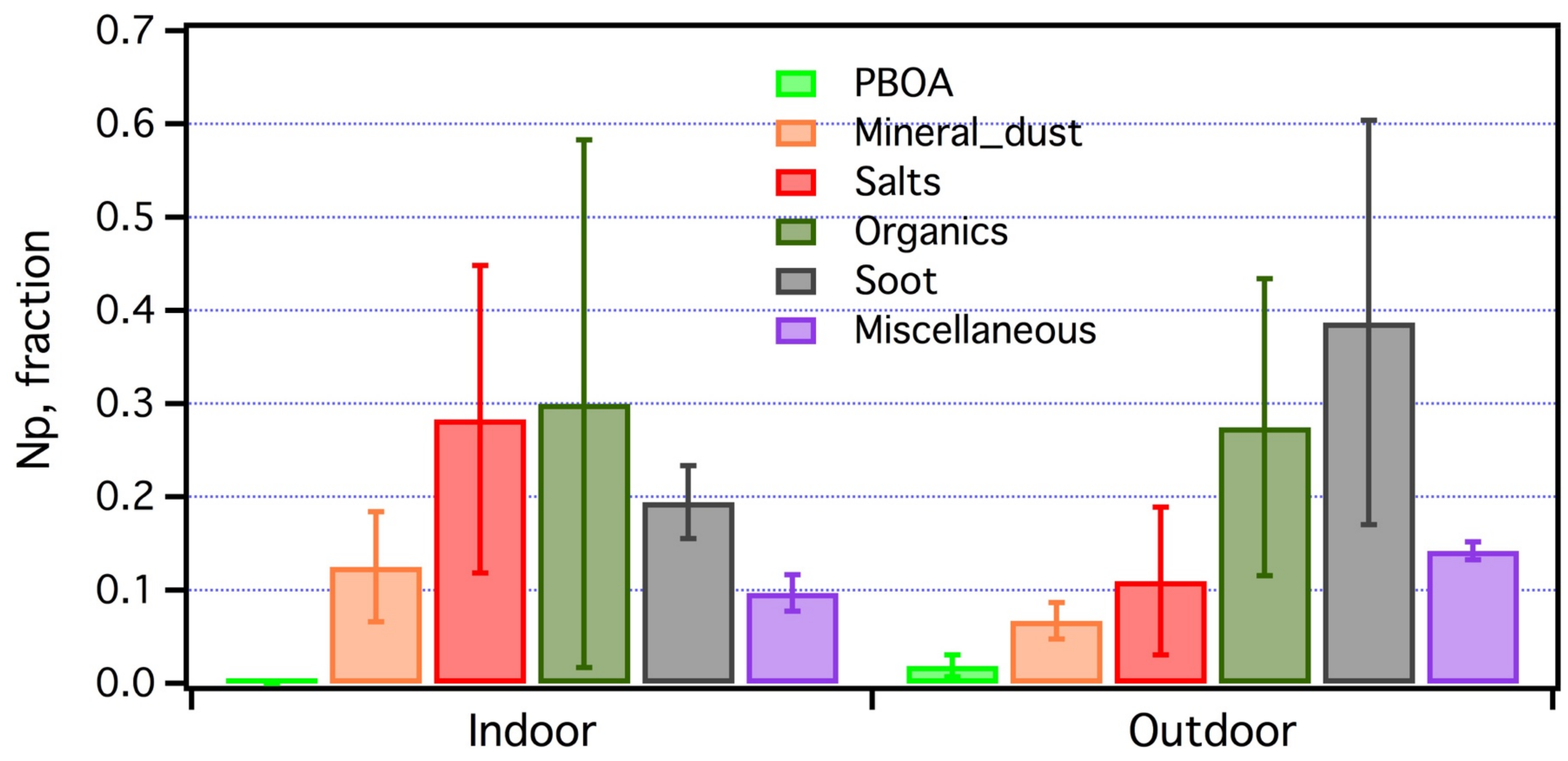

Figure 1. Cluster distribution by particle number fraction of the indoor samples at the gymnasium and outdoors the sports facilities during the period of study.

Indoor & outdoor particle size distributions

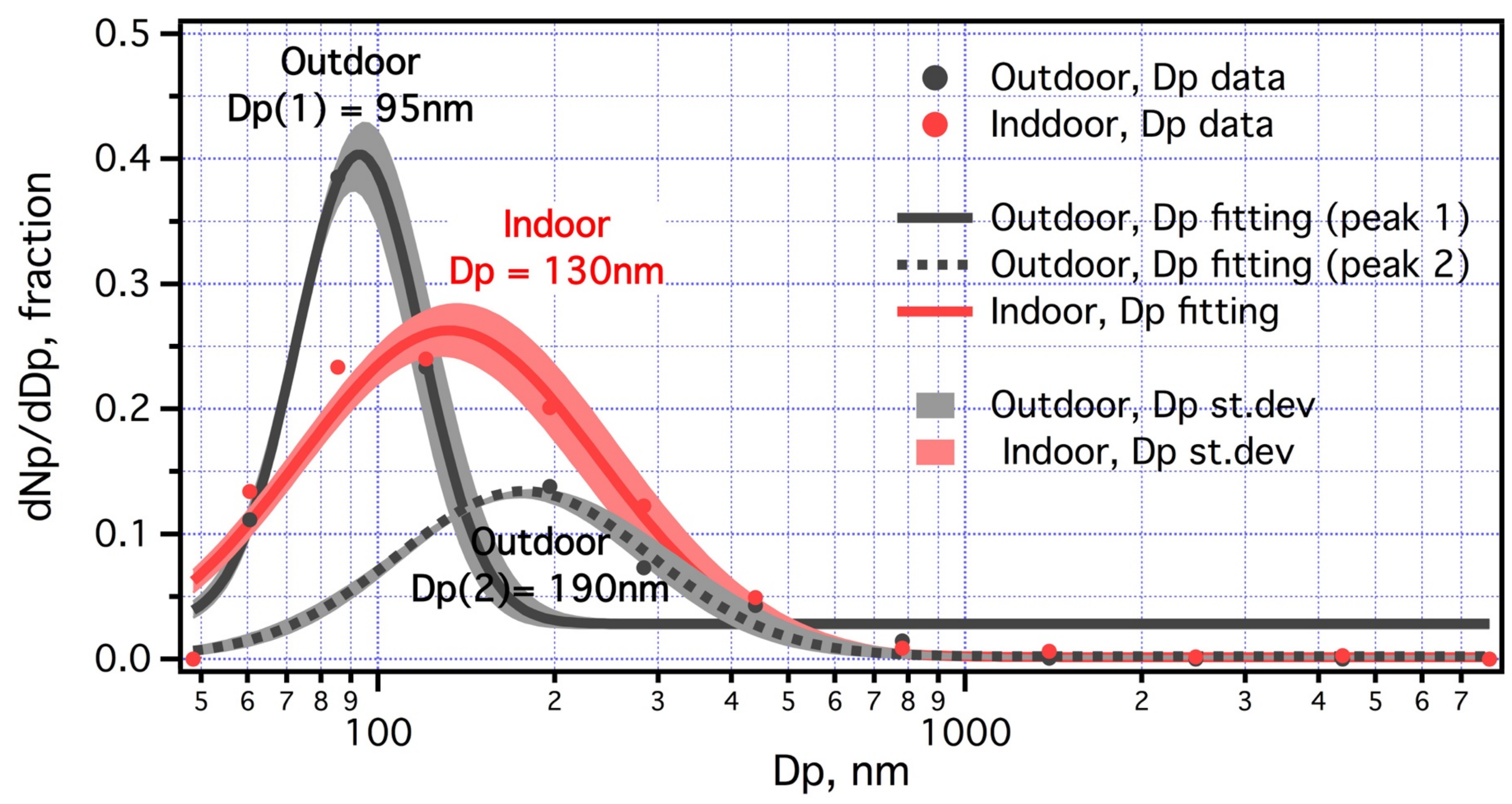

Figure 2. Size distribution (Dp) of the indoor samples at the gymnasium and outdoors the sports facilities during the period of study.

Examples of particles in the cluster types

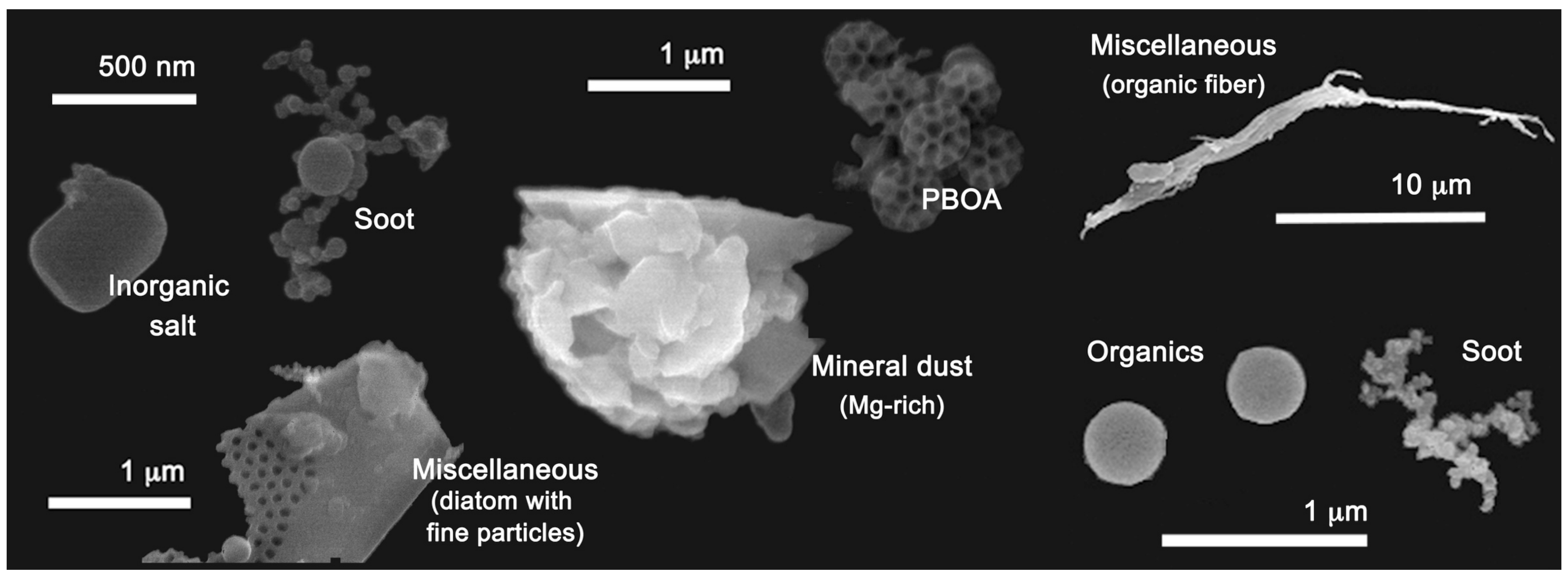

Figure 4. Examples of some of the typical particles in each of the cluster types: PBOA, mineral dust, salts, organics, soot and miscellaneous.

Indoor & outdoor particle morphology

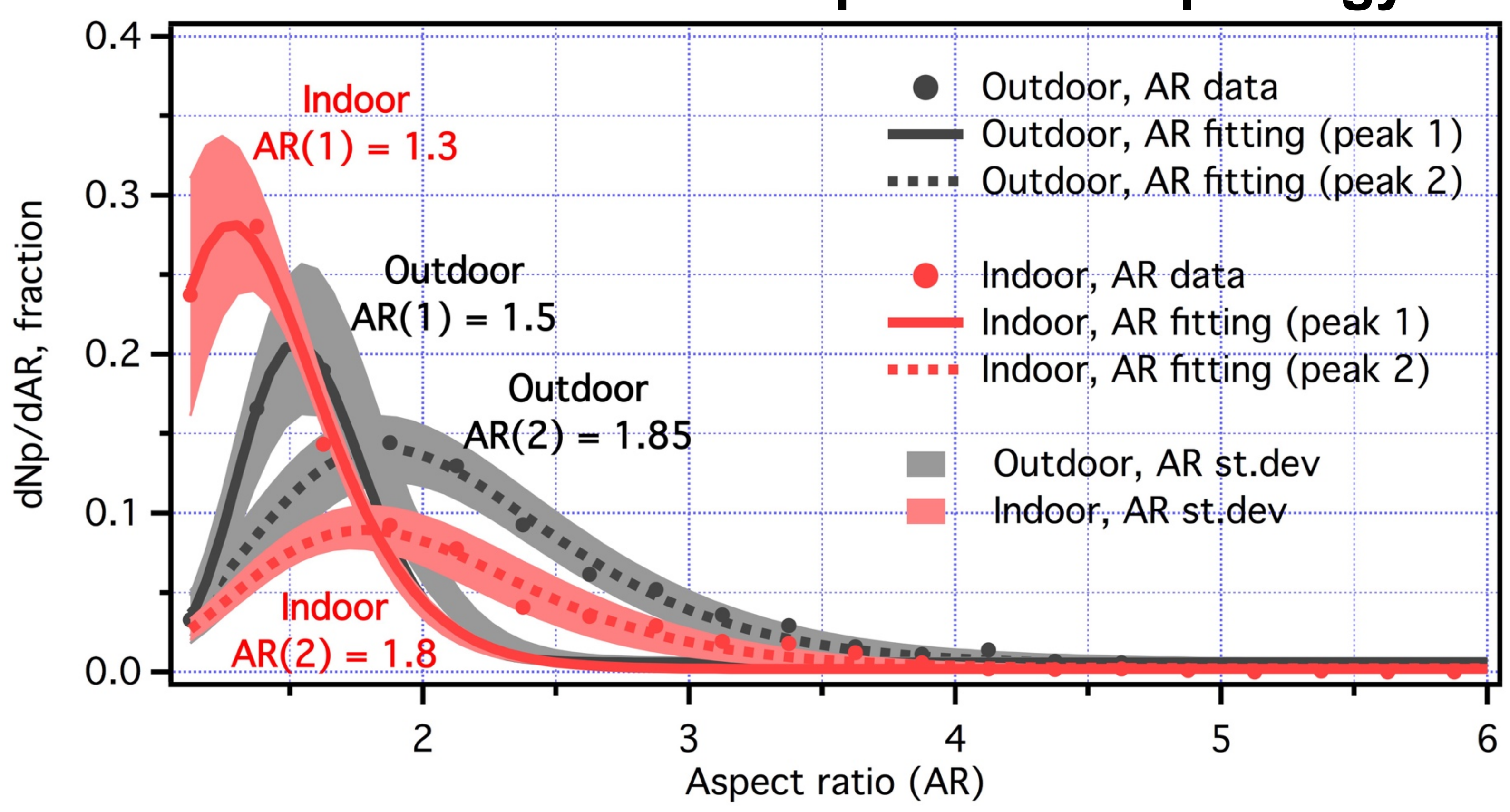

Figure 3. Aspect ratio (AR), maximun-to-minimun axis of the particle's equivalent regular ellipse, of the indoor samples at the gymnasium and outdoors the sports facilities during the period of study.

Results & Conclusions

- The indoor sports activities contribute to the production of mineral dust, organic compounds and nano-salts. The mineral dust fraction is mainly comprised of Mg-enriched particles, from the use of magnesia as an efficient moisture hand absorbent. Some organic debris was observed as a result of disintegration of the mattresses that covered the gym floor. However, the higher contribution of the sport activities to the organic fraction was found in the fine mode, as well as a high number production of nano-salts, possibly consequence of human perspiration.
- Considering the full soot cluster found indoors was consequence of outdoor-indoor exchange, and maintaining the outdoor cluster-to-soot ratio, 75% of the mineral dust, 70% of the organic and more than 80% of the inorganic particle number fraction indoors could be attributed on average to the physical activities.
- Interestingly, the PM attributable to the indoor activities, was not only associated to very small sizes but a higher degree of sphericity. This finding is extremely important in terms of toxicology since both smallest particle sizes and higher sphericity promote a deeper penetration into the respiratory system.

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